IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M07/4/BIOLO/HP3/ENG/TZ1/XX/M+

MARKSCHEME

May 2007

BIOLOGY

Higher Level

Paper 3

15 pages

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation
Candidates are required to answer **ALL** questions in each of **TWO** Options (total ***[20 marks]***). Maximum total = ***[40 marks]***.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- Words that are <u>underlined</u> are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option D — Evolution

D1. (a) 0.9 (±0.03) ***[1]***

(b) 0.63 (±0.02) ***[1]***

(c) heterozygous/AE lower median / less susceptibility to infection than homozygous/EE median ;
heterozygous/AE has a median of 0.35 (±0.03) and homozygous/EE has a median of 0.68 (±0.03);
heterozygous/AE smaller range (from 0.05 to 0.65) than homozygous/EE (from 0.14 to 0.95);
heterozygous/AE has a range from 0.05 to 0.65 and homozygous/EE has a range from 0.14 to 0.95;
heterozygous/AE and homozygous/EE medians have a similar/same degree of variation (error bars); ***[2 max]***

(d) heterozygous/AE is less susceptible/more resistant to infection than homozygous/AA/EE;
presence of hemoglobin E/allele E makes cells less susceptible to malaria;
both heterozygous/AE and homozygous/EE less susceptible than AA;
heterozygous/AE is fitter/selected for;
heterozygous/AE / allele E increases in frequency/is maintained in the population; ***[3 max]***

D2. (a)

Feature	*Australopithecus africanus*	*Homo erectus*
molars	larger	smaller;
brain	smaller	larger;

[2]

*Award **[1]** each correct row.*

(b) ^{40}K /potassium-argon ***[1]***
Do not accept ^{14}C .

D3. (a) reducing atmosphere / no (free) O_2 / anoxic;
ammonia / phosphoric salts / H_2 / CH_4 / CO_2 / H_2O vapour;
storms with lightning/electricity;
high UV levels/solar/high energy radiation;
(intense) volcanic activity;
high temperatures;
radioactive elements present; ***[4 max]***

(b) variation in the population;
variation produced by (random) mutation/recombination;
change in environment;
some individuals have characteristics that make them more adapted to their environment;
alleles fitter/selected for;
this variation is/better adapted inherited by the offspring;
they reproduce more;
allele increases in frequency / better adapted increase in frequency;
characteristics of the species gradually change/speciation;
e.g. black and mottled moths / other suitable example;
Darwin/Wallace; ***[6 max]***

Option E — Neurobiology and Behaviour

E1. (a) *causes*: ***[3 max]***
death/degeneration of neurons;
substantia nigra/basal ganglia;
trauma/drugs (*e.g.* heroin) /genetic;
no/reduced dopamine is produced;

symptoms: ***[3 max]***
uncontrollable shaking/muscle contraction not controlled/tremor/increased muscle rigidity;
slow movements;
poor balance;
speech impairment; ***[4 max]***

(b) *innate*: ***[3max]***
definition / develop independently of the environment / is inherited/instinct;
stereotyped behaviour / no change with practice/repetition;
innate behaviour develops by natural selection because they make a species better adapted to the environment / increase reproductive success;
taxis: movement to or away from a directional stimulus;
named example of taxis and how it helps *e.g.* fly larvae move away from light, protecting them from predators;
kinesis: response to non-directional stimulus;
named example of kinesis and how it helps *e.g.* woodlice move toward moist/dark places to avoid dehydration;
*Award **[2max]** if no named example of taxis/kinesis/reflex is given.*

learned: ***[3max]***
definition / depend on the environment/experiences;
natural selection will favour certain learned behaviours that increase reproductive success;
classical conditioning: conditioned response to a conditioned stimulus;
operant conditioning: trial and error / reinforcement given after operant response;
imprinting: learning a response in a receptive period;
named example and how it helps *e.g.* ducklings follow first thing they see that moves / mother when born to avoid predators;
conditioned behaviour based on response to rewards that increase survival; ***[6 max]***
*Award **[2max]** if no named example of classical conditioning/operant/imprinting is given.*

E2. (a) 19:00 hours ***[1]***

(b) $2\,m\,s^{-1}$ *(units required)* ***[1]***

(c) at 17:00 hours less (calling) area/distance than at 18:00 hours;
at 17.00 hours the maximum calling distance is just over 6 km whereas at 18.00 hours the maximum calling distance is just under 10 km;
both expand most in the direction of the wind/towards the south-west ***[2]***

(d) when there is no wind (at 19:00 hours) there is greatest calling area/distance/more than 10 km;
shape of the calling area is affected by the presence/direction of wind/when there is no wind the shape of the calling area is circular;
when there is wind the calling area/distance is associated with wind direction / calls travel furthest in the direction of the wind;
when there is wind there is no relationship between the wind speed and the distance travelled by the calls;
stronger calls could result in greater calling areas/distances (so wind has less effect) / other factors affecting (such as mountains); ***[3 max]***

E3. (a) thermoreceptors ***[1]***

(b) *Award **[1]** for any two correct labels.*
A: hypothalamus;
B: pituitary gland / hypophysis;
C: medulla (oblongata);
D: cerebellum; ***[2 max]***

Option F — Applied Plant and Animal Science

F1. (a) 20×10^6 tonnes of phosphorus fertilizer and 50×10^6 tonnes of nitrogen ***[1]***
Units required for both.

(b) 125 (%) ***[1]***

(c) greater amount of fertilizer used, greater production (general trend);
as the amount of nitrogen fertilizer increases the amount of cereal production increases / both scattergrams for nitrogen fertilizer and cereal production follow the same pattern;
as nitrogen fertilizer use increases from 10 to 80×10^6 tonnes the cereal production increases from 0.8 to 2×10^6 tonnes (over the time recorded);
up to 1975 as the amount of phosphorus fertilizer increases the cereal production also increases;
after 1975 the amount of phosphorus fertilizer remains constant, but the amount of cereal production continues to increase (greatly);
nitrogen fertilizer is more important than phosphorus fertilizer in increasing cereal production; ***[3 max]***

(d) greater yields so poor countries cannot compete;
chemical fertilizers may precipitate growth of water plants leading to eutrophication;
fertilizers can be transformed into toxic compound / soil pH may change/more acid (increasing the solubility of aluminum);
taste of food can change;
soil structure deteriorates;
(nitrates) are not safe to keep as are potentially explosive;
chemical fertilizers are expensive;
rapidly released when the plants are not necessarily using them;
may cause osmotic unbalance when added in concentrated forms; ***[2 max]***

F2. (a) asexual / formation of bulbs / vegetative reproduction ***[1]***

(b) definition: more than two full sets of chromosomes;
e.g. different corn species / wheat / bananas / cotton / potatoes / tobacco / sugar beet / tomatoes / chrysanthemums / dahlia / strawberries / pansies / apple / ginger tetraploid rat / flatworm / leech / brine shrimp *etc.*; ***[2]***

F3. (a) antibiotics protect animals against infection;
increase growth rates / less mortality (due to less infection);
better yields / more food available;
but controversy arises if used routinely in feed rations;
increase (rate of evolution of) resistant bacteria;
which will make it difficult to cure in the future / greater amount of antibiotic needed / new antibiotic needed to be used;
antibiotics can appear in milk/animal products;
causing allergy problems in humans;
not natural / animal has not choice in being given antibiotics; ***[6 max]***

(b) auxins (in shoot tip) promote apical dominance / suppress growth of axillary buds;
makes plant/stem grow in height;
auxins promote cell elongation;
auxins promote positive phototropism/growth towards light;
if shoot tip cut off then lateral shoots start growing;
plant grows more to the side than in height;
making the plant have a bushy shape; ***[4 max]***

Option G — Ecology and Conservation

G1. (a) chemoautotrophs oxidize inorganic compounds;
producing ATP;
this energy is then used to make complex organic compounds;
no light is required (to make ATP);
chemoautotrophy is only found amongst bacteria;
nitrifying bacteria are chemoautotrophs;
nitrogen fixing bacteria convert nitrogen to ammonia;
nitrifying bacteria oxidize ammonia or nitrite / requires supply of oxygen;
Nitrosomonas converts ammonia to nitrite;
Nitrobacter converts nitrite to nitrate;
works best under warm temperatures and alkaline pH;
nitrate can be up taken by plants; ***[6 max]***

(b) ozone layer forms in the stratosphere/15 km to 50 km in altitude;
CFC from aerosols/refrigerators/fire extinguishers/foam industry;
CFC diffuse to stratosphere;
UV light breaks down CFC releasing Cl;
chlorine reacts with ozone;
ozone is broken down to oxygen (and ClO);
reducing the amount of ozone / 1 Cl molecule destroys 100000 ozone molecules;
ClO reacts with O free radicals (changing to Cl and O_2); ***[4 max]***

G2. (a) 2300 m to 3000 m *(units required)* ***[1]***

(b) any value between 2700 m and 2800 m ***or*** 1200 m *(units required)* ***[1]***

(c) *Bolitoglossa* greater distribution, *Oedipina* less distributed;
both *Bolitoglossa* and *Oedipina* found between 1050 m and 1200m;
between 1200m and 1250m only *Oedipina* is found;
Bolitoglossa is found at low and high heights (except between 1400 m and 1800 m)
Oedipina is not; ***[2 max]***

(d) altitude may be a determining factor in the distribution of different genera of salamanders / each genus appears to have different, preferred altitudes;
at the species level each species (of a same genus) has a different altitude range in which it lives / not all salamanders (of same species) live at same altitude;
no two species can occupy the same niche/competitive exclusion principle;
B. striatula and *B.colonnea* share the same altitudes;
species may have different breeding sites/feeding habits/interactions with organisms (although at same altitude); ***[3 max]***

G3. (a) (net dry mass) of organic matter in living organisms/environment (in a given area usually per square kilometre) ***[1]***

(b) captive breeding/zoos/laboratories;
botanical gardens;
seed banks; ***[2 max]***

Option H — Further Human Physiology

H1. (a) zero/none died/0/0 % ***[1]***

(b) $52\,\text{m mol dm}^{-3} - 10\,\text{m mol dm}^{-3} = 42\,(\pm 1)\,\text{m mol dm}^{-3}$ *(units required)* ***[1]***

(c) intravenous after $85\,\text{m mol dm}^{-3}$, the glucose starts appearing in urine / glucose is no longer reabsorbed in kidneys/tubules;
up to $110\,\text{m mol dm}^{-3}$, the values in blood serum are close to normal / glucose excreted through urine / no mortality;
above $110\,\text{m mol dm}^{-3}$ / $115\,\text{m mol dm}^{-3}$, rats start dying / blood levels still close to normal/excreted through urine;
after $115\,\text{m mol dm}^{-3}$, values of glucose in blood/mortality start increasing drastically; ***[3 max]***

(d) the excess glucose in orally fed rats is egested/not absorbed;
in orally fed rats it enters body more gradually;
in orally fed rats it goes straight to liver while in injected rates it goes straight to rest of body;
in orally fed rats, insulin regulates blood sugar at all levels ($10\,\text{m mol dm}^{-3}$); ***[2 max]***

H2. chronic inflammatory disease of the airway / inflammation of airway;
allergic reaction to dust/mites/pollen/toxins/pets/fungi;
constriction of muscles of wall of bronchioles / bronchospasms;
more mucus is produced;
ventilation is hard / gas exchange reduced; ***[3 max]***

H3. (a) sinoatrial/SA node acts as a pacemaker/impulses are initiated here;
SA myogenic;
impulses/wave of excitation/contraction passes across the atria causing contraction/systole;
impulse/wave of excitation/contraction then passes to the atrioventricular/AV node/ time delay in the AV node;
impulse goes along fibres in the ventricular wall/Purkinje fibres/bundle of His;
ventricles contract when impulses pass;
innervation allows for variation in heart beat sympathetic nerve/adrenaline speeds up heart rate / vagus nerve/acetylcholine brings it back to the norm; ***[4 max]***

(b) body temperature monitored by hypothalamus;
when temperature drops neurosecretory cells/hypothalamus produce thyrotropin releasing hormone/TRH;
TRH travels to the (anterior lobe of) pituitary (via the portal vein);
pituitary secretes thyroid stimulating hormone/TSH;
TSH travels to thyroid gland;
thyroid secretes thyroxin;
thyroxin increases metabolic rate;
heat produced by increased metabolism increases body temperature / heat produced by metabolism inhibits production of thyrotropin releasing hormone/TRH;
blood levels of thyroxin monitored by both hypothalamus and anterior pituitary;
thyroxin/T3/T4 levels regulated by negative feedback;
high levels of thyroxin/T3/T4 inhibit TRH secretion; ***[6 max]***
Accept TRF or TSH releasing factor instead of TRH. Accept converse statements for increase in body temperature.